CptS/EE 455 Fall 2016 Midterm 1 Sample Exam

You may have one $8\frac{1}{2} \ge 11$ sheet of notes for this exam. Computers, phones and other electronics are **not** allowed **except** that use of a calculator is allowed (but should not be necessary). There are **8** numbered questions, some with multiple parts on **6** pages totalling 102 points. Problem 5c) is extra credit worth 4 points. *Please make sure that your copy of the exam is complete before starting*.

Answer **all** the questions in the space provided. This is a **50 minute** exam, 10:10 - 11:00. Exams will be collected promptly at 11:00.

1. (10 points) Terms and Concepts: short answers (at most 3-4 sentences)

a) Explain why the TCP congestion control mechanism almost guarantees that at least some segments will be dropped in a TCP connection over which the sender is trying to send as fast as possible.

b) How can you resolve the statement in part a) with the observation that video and audio streaming applications, at least sometimes, do *not* suffer from dropped segments even when using TCP.

2. (20 points) Host A and Host B are connected by a network that has a bandwidth of 5 megabits/second. The hosts are separated by 5000 kilometers and the network propagation speed is 250,000 kilometers/second. Host A sends 5,000-bit packets to Host B at the rate of 100 packets/second. *Give proper units on each answer*. (For these and other numerical problems it is *required* that you give a formula, using numbers from the problem, that can be evaluated to give the numerical answer.)

a) What is the **propagation delay** between A and B?

b) What is the **transmission time** of a single packet?

c) What is the **bandwidth-delay product** for this link (one-way)?

d) What is the **utilization** of the link due to this traffic?

e) If this is the only traffic on the link, how much queuing delay would you expect it to encounter?

3a. (4 points) List the socket library system calls typically used by a TCP network server, *in the correct order of use*.

3b. (4 points) List the socket library system calls typically used by a TCP network client, *in the correct order of use*.

4. (12 points) Protocol layering

a) What layer of the IP protocol stack is associated with the DNS protocol?

b) What *protocol* sits below UDP in the IP protocol stack? What is the name of the protocol *layer* associated with this protocol?

c) What protocol layer sits below the link layer?

5. [8 points] a) For a TCP connection the current EstimatedRTT is 50ms. If the next SampleRTT is 100ms what is the new value of EstimatedRTT if alpha, the multiplier applied to SampleRTTs is 0.2. *Remember to give formulas, with numbers, that when evaluated will yield the answer.*

b) For the same TCP connection the DevRTT started out at 20ms. What is DevRTT after the sampleRTT in part a) of the problem is processed.? Assume that beta, the multiplier applied to the difference between the sampleRTT and the EstimatedRTT at each step is 0.20.

c) [Extra credit – do only if you have time – 4 pts] Assuming that this TCP connection is transmitting a segment every 10ms and that the timeout has been set according to the initial conditions given in the previous two problems (i.e. EstimatedRTT=50ms, DevRTT=20ms) *estimate* how much sooner TCP *fast retransmit* resends a missing packet than would happen if it waited for the timeout.

6. (12 pts) We talked in class and you solved homework problems about performance improvements achieved using HTTP caching. DNS caching is perhaps even more important. Suppose that the average response time for DNS queries made to DNS servers outside the enterprise is 50ms, and that the average number of components in names looked up is 4 (e.g. <u>www.eecs.wsu.edu</u> has 4 components but <u>www.wsu.edu</u> has only 3).
a) If there is no DNS cache what is the average time required to look up a name? Remember that looking up a name involves looking up each of its components.

b) If there is a DNS cache with a *miss* ratio of 40% and a response time of 1ms when a cache hit occurs, what is the average time required to look up a name?

c) In problem 9 of chapter 2 we saw that one of ways an HTTP cache would improve response time was by reducing link access time due to lower utilization. Would you expect the same benefit to occur with DNS caching? *Why or why not*?

7. (12 pts) In a computer memory, at the addresses in the left column the bytes in the right column are stored (both the addresses and the byte values are hex):

0x1000	20
0x1001	30
0x1002	03
0x1003	02

a) If the processor uses *big-endian* representation, what numerical value is represented by the *4-byte unsigned integer* whose (start) address is 0x1000? (Write a formula)

b) If the processor uses *little-endian* representation, what numerical value is represented by the *2-byte unsigned integer* whose (start) address is 0×1002 ? (Write a formula)

c) If the processor uses *little-endian* representation, what numerical value is represented by the *2-byte unsigned integer* whose address is 0x1002 after the htons function has been applied? That is, what is the numerical value of htons (* ((uint16 *) 0x1002)) ? (Write a formula) 8. (20 points) Miscellaneous short answer

a) When a TCP receiver receives a segment with SEQ==1000 and LEN==200, and has received all prior segments and no later segments on the connection, what is the value of the ACK field in next segment that it sends?

b) If the next segment the receiver receives after the one described in question 7a has SEQ==320 and LEN==120 what has happened?

c) What is the value of the ACK field in the next segment sent by the receiver following receipt of the segment described in question 8b?

d) Suppose that instead of what is described in 8b, the next segment received after the one described in 8a had SEQ==1400 and LEN==100. What has happened?

e) What specific occurrences indicate to a TCP sender that congestion is occurring? (You need to say something beyond "packet drops" – what events cause the TCP congestion control state machine to notice that packets have been dropped?)